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THE FRESHWATER FOOD HABITS OF JUVENILE ARCTIC CHAR IN STREAMS IN THE ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA

Key Words
Food habits, Arctic char, Arctic National Wildlife Refuge

Tonya M. Stevens
Stephen J. Deschermeier

Fairbanks Fishery Resources Station
U.S. Fish and Wildlife Service
101 12th Avenue, Box 20, Rm. 110
Fairbanks, Alaska 99701

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Tonya M. Stevens and Stephen J. Deschermeier. U.S. Fish and Wildlife Service, Fishery Resources, Fairbanks, Alaska.

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INTRODUCTION

The Fairbanks Fishery Resources Office has conducted baseline survey and inventory studies of the fishery resources of the North Slope of the Arctic National Wildlife Refuge (ANWR) since 1981 under the direction of Sec. 1002(c) of the Alaska National Interest Lands Conservation Act of 1980. Arctic char (Salvelinus alpinus) were sacrificed during these studies for age and growth information and digestive tracts were often removed to learn food habits of fish in the study streams. Some of the char collected could not be aged; however, it is assumed that all char examined for this report were juveniles (under 5 years), based on length comparisons with fish of known ages taken from the same streams at the same time of year.

Four life history types have been described for North Slope Arctic char (McCart 1980): one anadromous form and 3 non-anadromous forms. The non-anadromous forms have been categorized as stream-residents [stream-resident char have also been referred to as "residual Arctic char" (Craig 1977a)], lake-residents or spring-residents. The juveniles examined for this report were either anadromous, stream-resident, or spring-resident char; due to the difficulty of differentiating between these types during the juvenile stage, only those char taken from Shublik Spring (a tributary to the Canning River) are of known type. No separation between stream-resident and anadromous juveniles was made for this analysis.

The objective of this study was to provide baseline information concerning food habits of juvenile Arctic char from streams on the North Slope of the ANWR.

METHODS

Juvenile Arctic char were taken from the Canning River in 1982, from the Aichilik River in 1982 and 1983, from the Hulahula River in 1983, and from the Kongakut River in 1985 (Fig. 1). The sampling sites are described in detail in Smith and Glesne (1983), Daum et al. (1984), and Deschermeier et al. (1986). Fish were collected with a variety of gear: hook and line, electroshocker, minnow traps, gillnets, and seines (Table 1). Table 1 gives the date and location of the sampling sites on each river, the sample sizes, the number of fish collected, and the number of empty stomachs.

Both whole fish and separate digestive tracts were preserved in the field in solutions of approximately 10% formalin. The fork lengths of whole fish measured after preservation were adjusted for shrinkage (Parker 1963). Stomach contents were removed from formalin and transferred to isopropyl alcohol before examination.

Keys used for identification of organisms comprising stomach contents were Oliver et al. (1978), Pennak (1978), and Merritt and Cummins (1984). Organisms were viewed with a 1-7x Bausch and Lomb dissecting scope and a Bausch and Lomb microscope (10-40x).

Sample sizes were insufficient for statistical testing, therefore stomach contents were not analyzed in detail. Relative biomass of food organisms was

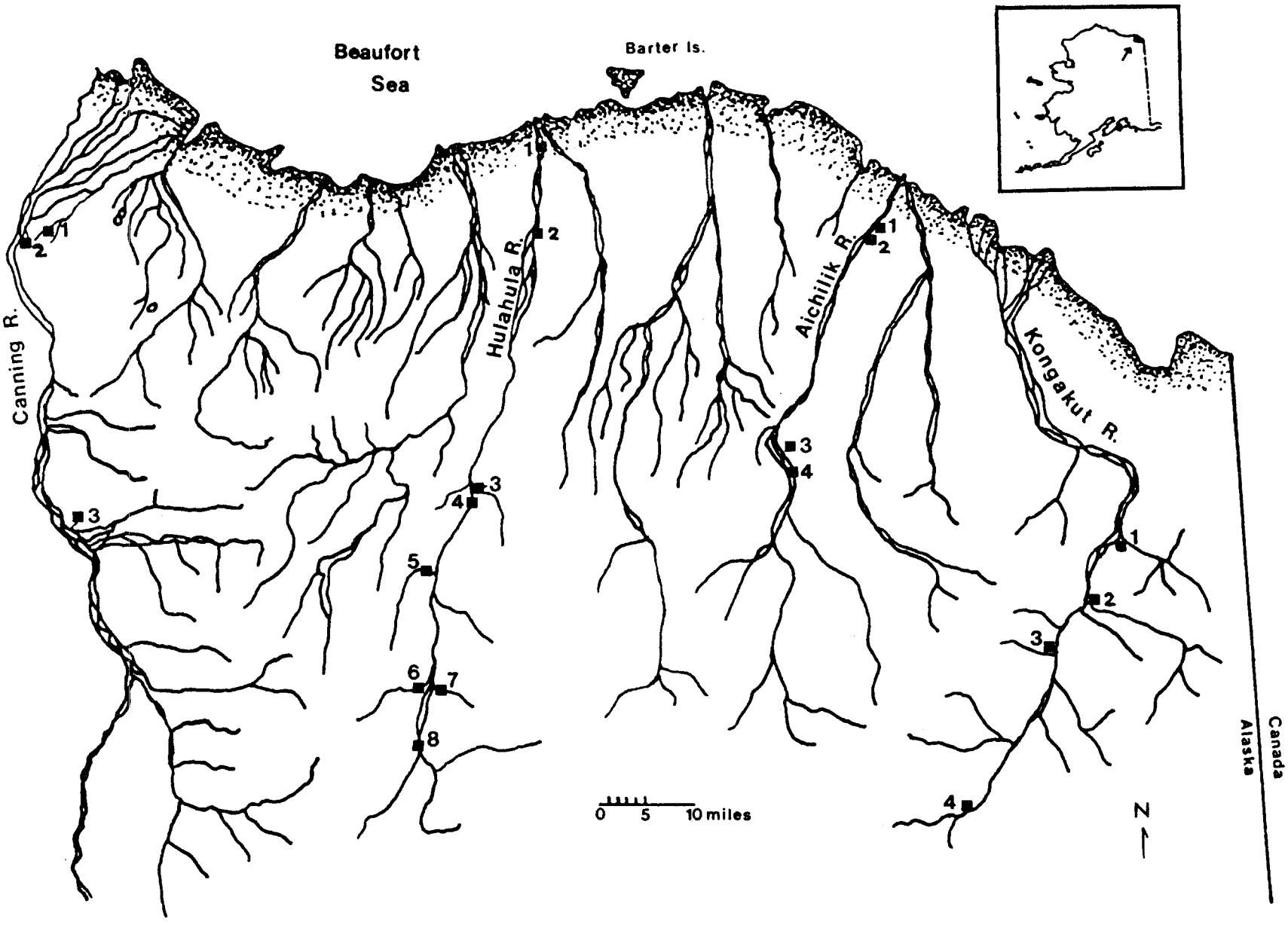

Figure 1. Collection sites on four river drainages in the Arctic National Wildlife Refuge, Alaska. Table 1 gives sampling dates and location names for each number on the map.

Table 1. Dates of fish sampling, gear type used, fork length range of fish collected, number of Arctic char stomachs collected and the number of empty stomachs, August 1982 - July 1985, Arctic National Wildlife Refuge, Alaska; ES = electroshocker, MT = baited minnow traps, S = seine, GN = gill-net, A = angling.

Figure 1 Location	Sampling site no.	Sampling date	Gear type	Fork length range (mm)	Number of stomachs collected	Number of empty stomachs
Canning River						
Coastal trib.	1	8-4-82	ES	57 - 155	7	0
Coastal trib.	2	8-2-82	ES	83 - 151	15	0
		8-9-82	MT	77 - 136	4	0
		8-10-82	MT	85 - 106	2	0
		8-11-82	ES	60 - 136	3	0
		8-12-82	MT	135	1	0
		8-14-82	MT	128 - 140	3	1
Shublik Spring	3	9-19-82	ES	45 - 158	9	0
					44	1
Hulahula River						
Near mouth	1	8-8-83	S	64	1	0
	1	8-31-83	S	66 - 72	4	1
Lower river	2	7-16-83	ES	78	1	0
Old Man Creek	3	7-16-83	ES	65 - 110	13	0
Fish hole II	4	8-15-83	ES	45 - 93	3	0
	4	9-19-83	MT	51 - 131	12	3
Katuk Creek	5	7-16-83	ES	69 - 136	13	0
W. Patuk Creek	6	7-15-83	ES	106 - 185	22	1
E. Patuk Creek	7	7-15-83	ES	99 - 136	7	1
Grasser Strip	8	8-13-83	ES	174 - 218	2	0
					78	6

Table 1 continued

Figure 1 Location		Sampling date	Gear type	Fork length range (mm)	Number stomachs collected	Number stomachs empty
Aichilik River						
	1	7-4-83	ES	117 - 178	7	0
	2	7-3-83	ES	118 - 182	5	0
	3	7-4-83	ES	74 - 171	15	8
	4	9-20-82	MT	117 - 131	2	0
			GN	125	1	0
			A	107	1	0
		9-21-82	MT	70 - 108	3	0
			GN	113 - 120	2	0
					36	8
Kongakut River						
	1	7-2-85	MT	73 - 153	18	5
	2	7-1-85	MT	86 - 141	10	3
	3	6-29-85	MT	149 - 160	2	0
	4	6-24-85	MT	101	1	0
					31	8
Totals					189	23

Table 2. Stomach contents of juvenile Arctic char from four drainages of the Arctic National Wildlife Refuge, Alaska, 1982 - 1985; A = adult, P = pupae, L = larvae, N = nymph. Results are given as percent frequency of occurrence and percent compostion of stomach items. Empty stomachs were not included in the calculations.

		Canning River		Hulahula River		Aichilik River		Kongakut River	
Organism		% Freq.	% Comp.	% Freq.	% Comp.	% Freq.	% Comp.	% Freq.	% Comp.
Unidentified Diptera	A	48.8	2.6	50.0	0.7	53.6	0.8	12.5	0.6
	P	16.3	1.3	11.0	0.2	17.9	0.1	12.5	0.6
	L			0.5	*	3.6	*	4.2	0.2
Chironomidae	P	58.1	8.5	29.2	1.0	53.6	1.3	8.3	0.4
	L	93.0	74.6	98.6	92.0	92.9	88.0	91.7	86.0
Tipulidae	L	4.7	0.1	27.8	*	10.7	*	41.2	3.6
Simulidae	P	18.6	0.5						
	L	30.2	2.9	15.3	0.2	28.6	1.4		
Empididae	L	9.3	0.1	22.2	*	3.6	*	16.7	2.1
Psychodidae	L	2.3	0.1	1.4	*				
Plecoptera	N	23.3	0.5	62.5	5.0	53.6	2.3	29.2	2.3
Ephemeroptera	N	55.8	6.5	27.8	0.6	28.6	3.9	16.7	1.3
Coleoptera	A	13.9	0.3	6.9	*	17.9	0.1	8.3	0.6
	L	7.0	0.1	6.9	*	25.0	0.6	4.2	*
Trichoptera	L	25.6	1.3	2.8	*				
Hemiptera	A			9.7	*	14.3	0.1		
Collembola	A	2.3	*	6.9	*	7.1	*		

Table 2 continued

Organism	Canning River % Freq.	Canning River % Comp.	Hulahula River % Freq.	Hulahula River % Comp.	Aichilik River % Freq.	Aichilik River % Comp.	Kongakut River % Freq.	Kongakut River % Comp.
Amphipoda					7.1	1.3		
Hydracarina	16.3	0.3	1.4	*	3.6	*	4.2	0.2
Araneae			6.9	*	7.1	*		
Nematoda	9.3	0.1	13.9	0.1	14.3	0.1	4.2	0.2
Unidentified terrestrial insects	9.3	0.1	19.4	0.1	10.7	*		
Fish	2.3	n	2.8	n			16.7	n
Sample size	43		73		26		24	
Total number of organisms		6,207		42,874		23,438		472

* = Items that constituted less than 0.1 % of the composition.
n - Fish were not included in calculation of percent composition.

Table 3. Stomach contents of juvenile Arctic char, by length group, from four drainages in the Arctic National Wildlife Refuge, Alaska, 1982 - 1985. Results are given as percent frequency of occurrence and percent composition of stomach items. Fish captured in minnow traps and those with empty stomachs were not included in the analysis.

		Size class					
		40 - 99 mm		100 - 149 mm		150 - 221 mm	
Organism		% Freq.	% Comp.	% Freq.	% Comp.	% Freq.	% Comp.
Unidentified Diptera	A	30.8	0.6	62.1	0.7	70.8	1.0
	P	15.4	0.3	12.1	0.4	4.2	*
	L			1.7	*	16.7	*
Chironomidae	P	26.9	1.5	39.7	0.7	54.2	3.4
	L	88.5	80.2	98.2	93.0	95.8	86.2
Tipulidae	L	7.7	*	29.3	0.1	16.7	*
Simulidae	P	3.8	0.1	5.2	*	4.2	*
	L	23.1	3.3	24.1	0.5	25.0	0.7
Empididae	L	3.8		27.6	0.1	8.3	
Psychodidae	L					4.2	*
Plecoptera	N	38.5	9.3	53.4	2.0	54.2	4.9
Emphemeroptera	N	61.5	4.2	17.2	1.4	41.7	2.5
Coleoptera	A			13.	*	20.8	0.1
	L	3.8	*	10.3	*	37.5	0.5
Trichoptera	L	3.8	0.1	10.3	0.1	16.7	0.2
Hemiptera	A			6.9	*	20.8	0.1
Collembola	A	3.8	*	5.2	*	16.7	*
Amphipoda				3.4	0.7	4.2	*
Hydracarina				5.2	*	29.2	0.1
Araneae		3.8	*	3.4	*	16.7	*
Nematoda		7.7	0.1	10.3	0.1	25.0	0.2
Unidentified terrestrial insects		3.8	0.1	20.7	0.1	33.3	0.1
Fish				3.4	n	4.2	n
Sample size		26		58		24	
Total organisms			4,296		43,694		27,312

* = Items that constituted less than 0.1 % of the stomach contents.
n - Fish were not included in the calculation of percent composition

not taken into account, nor was there an attempt to identify the contribution of micro-organisms, detritus or plant material in the diet of the juvenile Arctic char examined for this report.

Stomach contents are listed in terms of percent frequency of occurrence and percent composition of all stomachs combined. In Table 2, results are grouped by the drainage from which fish were taken; in Table 3, results are grouped by arbitrarily determined size classes.

RESULTS

Dipteran larvae of the family Chironomidae comprised the overwhelming majority of the diet of almost all fish examined, in terms of both frequency of occurrence and percent composition. Only 2 of 166 fish examined contained other organisms in greater number; these two char (from the lower Aichilik River) were full of amphipods. Adult dipterans also occurred frequently but comprised a small proportion of the diet. The frequency of occurrence of dipteran adults increased with an increase in size class.

The next most frequently eaten organisms appeared to be Plecopteran (stonefly) nymphs, except in the fish from the Canning River, in which Ephemeropteran (mayfly) nymphs were found more frequently and made up a greater portion of the total contents.

Seven char from three drainages had remains of fish in their stomachs. These remains were presumed to be Arctic grayling (Thymallus arcticus) young-of-the-year, based on their sizes. The smallest char, from the Kongakut River, was 118 mm long and weighed 10 g, and had recently eaten 2 grayling each 18 mm long.

The stomach contents of the spring-resident char differed slightly from those of fish from the main Canning River. They contained many Trichoptera larvae and larvae of the dipteran family Psychodidae. These organisms were found only in stomachs of fish from Shublik Spring and in a few fish from the Hulahula River.

DISCUSSION

The stomach contents of juvenile Arctic char from four drainages flowing into the Beaufort Sea appear to be similar to those examined in other studies (Bain 1974, Craig 1977a, b, c). Dipteran larvae, primarily Chironomids, constituted the greatest portion of the diet.

Although these char appeared to rely greatly on Chironomid larvae as a food source, there were many other insect and invertebrate orders represented in stomach samples. It was not difficult to judge that Chironomids dominated in both numbers and biomass; however, the contribution of other organisms to the diet of juvenile char is not apparent when merely reviewing the tables presented in this report. McCart (1980) discussed the inadequacies of describing food habits using data expressed in the form of percent frequency of occurence and percent composition. Despite the drawbacks to this system,

it was chosen as the style of analysis and presentation because it has been used by other researchers who have reported char food habits (Grainger 1953, Bain 1974, Craig 1977a, b, c, Sparholt 1985) and thereby allows gross comparisons to be made between fish from different areas.

Most unfairly represented in terms of contribution to the diet were the stonefly and mayfly nymphs which were found in the majority of stomachs. These organisms varied greatly in size ; many of the char stomachs contained large nymphs in small numbers. The data describing these stomach contents showed that whereas either mayfly or stonefly nymphs may have occurred quite frequently, they comprised a small percent of the numbers of organisms composing the diet in general. This should not mislead readers to believe that they were an unimportant component of the diet. Most other organisms were more satisfactorily represented in Tables 2 and 3 than stonefly and mayfly nymphs.

Ephemeropterans were found in greater frequency than plecopterans only in stomachs of the fish from the Canning River. The difference is most likely due to the varying time of emergence of the nymphs in the areas in question, rather than an actual preference of char for mayfly nymphs on the Canning.

Johnson (1980) and McCart (1980) describe char as opportunistic feeders. The variety of organisms and the differences in composition of stomach contents of char from different drainages in this study are indications that their classification is likely true for the juvenile char from streams of the North Slope of the Arctic National Wildlife Refuge.

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